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PCT

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(PCT Rule 61.2)

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in its capacity as elected Office

Date of mailing (day/month/year) 28 August 1998 (28.08.98)	
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International filing date (day/month/year) 23 January 1998 (23.01.98)	**Priority date** (day/month/year) 24 January 1997 (24.01.97)
Applicant WALTERS, John et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

06 August 1998 (06.08.98)

[ ] in a notice effecting later election filed with the International Bureau on:

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[ ] was not

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NON-WOVEN INORGANIC FIBRE MAT

This invention relates to a non-woven inorganic fibre mat such as a glass fibre mat and to a method and apparatus for the production thereof. It also relates to the use of the mat in building boards, such as gypsum building boards.

A particularly useful form of building board is known as glass reinforced gypsum board (GRG). GRG board and its manufacture is described in GB-A-2 053 779. GRG board is of generally conventional appearance and is composed of a gypsum with a non-woven glass mat immediately below one or both principal surfaces. The mat is introduced into the core by vibrating the core slurry, over- or underlain by the mat, to cause it to pass through the mat, so that the surface layer or layers of gypsum are integral with the core. GRG boards are stronger than conventional boards and exhibit superior fire resistance.

In the manufacture of GRG board the need to provide strength by employing non-woven glass fibre mat of relatively low diameter (for example, 13μm) fibres conflicts with the need to ensure efficient exhaustion through the mat of air from the gypsum slurry from which the board is formed; this is a particular problem at the edge margins of the board where the bottom mat is brought up and onto the upper surface of the board to define the edges of the uncut board. Inefficient exhaustion of air in this region can lead to voids in the edge margins of the cut boards, reducing the edge strength of the boards.

The problem of voids in the edge margins has been dealt with by increasing the fibre diameter of the mat, particularly the bottom mat (to for example 16μm), allowing easier exhaustion of air and penetration of gypsum slurry but reducing board strength. However, the use of higher diameter fibres has been found to decrease the strength of the mat. Reduction of the mat substance (weight/unit area), which would allow the gypsum slurry to

penetrate the mat more readily, would lead to an unacceptable reduction in board strength.

The need to allow sufficient time for the gypsum slurry to penetrate the mat means that the line speed of the plasterboard manufacturing line is lower than would be the case were adequate exhaustion of air from the edge margins easier.

It has been desired to provide a GRG building board which can be manufactured at relatively high speed, is of high strength by virtue of using a mat of relatively low diameter fibres and the edge margins of which have a low level of voids.

According to the invention there is provided a non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction.

Preferably, the edge margins are of lower substance than the remainder of the mat.

Also, according to the invention there is provided a method of making a non-woven mat of inorganic fibre having a substance which varies in the cross direction comprising:

passing a forming wire past a slurry of inorganic fibres in a liquid while masking a part of the width of the forming wire as it passes through the slurry, the masking varying along the length of the forming wire as it passes through the slurry; and

urging the slurry against the forming wire and causing the said liquid to pass through the forming wire, whereby a non-woven mat of inorganic fibre is formed having an uneven substance in the cross direction (the cross direction is the direction on the mat generally perpendicular to the direction in which the mat runs through the machine, which is the machine direction).

Also according to the invention there is provided apparatus for forming a non-woven mat of inorganic fibre having a substance which varies in the cross direction comprising:

a source of a slurry of inorganic fibre in a liquid;

a forming wire disposed to move past the said source, through which, in use, the said liquid passes to deposit the said

inorganic fibre on the forming wire;

a mask across a part of the width of the forming wire to hinder passage of the said liquid through the forming wire over the said part, the effectiveness of the mask varying in the direction of movement of the forming wire past the said source.

Preferably, the mask is disposed across portion of the forming wire corresponding to the edge margins of the formed mat.

Also preferably, the effectiveness of the mask decreases in the direction in which the forming wire is disposed to move.

Also preferably, the mask is a blinding plate impinging the face of the forming wire remote from the source of slurry.

Also preferably, the effective width of the blinding plate decreases in the direction in which the forming wire passes the slurry.

The invention also provides a cementitious board having a sheet of a non-woven mat of inorganic fibre according to the invention embedded immediately below at least one surface.

In a further aspect, the invention also provides a cementitious board having a sheet of a non-woven mat of inorganic fibre embedded immediately below at least one surface wherein the permeability of the mat to cementitious slurry varies across the mat.

The invention will be further described by way of example, with reference to the drawings in which:

Figure 1 shows, diagrammatically, a perspective view of an inclined wire glass fibre mat former embodying the invention;

Figure 2 shows a blinding plate for use in the apparatus and method of the invention; and

Figure 3 shows a cross sectional view through a glass fibre mat according to the invention.

The former shown in Figure 1 comprises a flowbox 10 containing an aqueous slurry of chopped glass fibre and conventional additives up to the level indicated by the broken line 12. The slurry is continuously supplied to the flowbox 10

from below. A continuous forming wire 14, shown transparent in Figure 1 for clarity, passes through the flowbox 10 at angle to the vertical and the horizontal in the direction shown by the arrow in Figure 1. Slurry is drawn through the wire 14 and into a suction box 16 by a conventional slurry pumping system to form a mat 18 of glass fibres on the wire. Shortly after leaving the flowbox 10, the forming wire 14 carrying the mat 18 of fibres passes over a vacuum header 20 which draws water from the mat 18. The mat 18 on the forming wire 14 then has adhesive applied to it and is dried and wound into a roll, in a conventional manner. The other rollers and the frame shown in Figure 1 are conventional.

Blinding plates 22,22', shown also in Figure 2, are placed in the flowbox 10 between the edge margins of the forming wire 14 and the suction box 16; the forming wire 14 passes across their surface. The blinding plates 22,22' are generally rectangular with a rectangular cut out 24,24' from their inside downstream (relative to the forming wire 14) corner. The presence of the blinding plates 22,22' as the wire starts to pass over the suction box 16 prevents the passage of slurry through the forming wire 14 in the region underlain by the blinding plates and so no glass fibres accumulate on the wire. As the wire 14 passes over the cut outs 24,24' from the blinding plates, slurry passes through the edge margins of the wire previously underlain by the blinding plates and glass fibre mat accumulates. The central portion of the forming wire 14 is not masked at all by the blinding plates 22,22', and so the glass fibre mat accumulates there throughout the passage of the forming wire over the suction box.

The effect of this differential accumulation of glass fibres is to make a mat having edge portions 26,26' of lower substance (weight/unit area) than the central portion 28. This may be seen in Figure 3. The substance of the edge margins 26,26' of the mat can be controlled by the size of the cut-outs 24,24' from the blinding plates 22,22' and the position of the blinding plates relative to the suction box 16. Factors such as the

concentration of fibres in the slurry, the speed of the forming wire and the speed with which the slurry is drawn through the forming wire, which generally affect the deposition of fibres on the wire and thus the substance of the mat will also affect the substance of the edge margins 26,26' of the nut 18.

Glass fibre mats according to the invention find particular application in the manufacture of GRG board, described in GB-A-2 053 779. The mat is introduced into the core by vibrating the core slurry, over- or underlain by the mat, to cause it to pass through the mat, so that the surface layer or layers of gypsum are integral with the core. The lower substance of the edge margins of the mats allow air trapped in the slurry to pass readily through the edge margins of the mat. This avoids the formation of undesirable voids in the edge margins of the board, improving edge strength. Preferred mats for this purpose are of 13 μm diameter glass fibres and have a central substance of about 60 g/m² and an edge margin substance of about 27 g/m².

Blinding plates of the invention may be of any desired size and shape to achieve the desired substance distribution across the width of the mat. They may be located at one or both edge margins of the forming wire 14, or one or more may be disposed across the width of the wire. The blinding plates may rest on the wire or be otherwise disposed over the wire but are preferably under it, between it and the suction box 16.

Instead of separate blinding plates, deposition of fibres on the forming wire can be inhibited by treating the wire itself, for example by painting over small areas in regions of the wire to be masked, so that less slurry passes through the wire in these regions, reducing the fibre deposition and thus mat substance. Alternatively, the weave of the forming wire can be made closer in some regions, again reducing the flow of slurry through these regions.

The mats of the invention allow the provision of GRG type plasterboard of improved strength especially at the edge margins.

Plasterboard having the same strength edge margins as current GRG boards can be manufactured at higher speeds than are currently possible.

CLAIMS

1. A non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction.

2. A mat according to claim 1 in which the edge margins are of lower substance than the remainder of the mat.

3. A method of making a non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction comprising:

passing a forming wire past a slurry of inorganic fibres in a liquid while masking a part of the width of the forming wire as it passes through the slurry, the masking varying along the length of the forming wire as it passes through the slurry; and

urging the slurry against the forming wire and causing the said liquid to pass through the forming wire, whereby a non-woven mat of inorganic fibre is formed having an uneven substance (weight/unit area) in the cross direction.

4. A method according to claim 3 in which the masking decreases in the direction in which the forming wire passes the slurry.

5. A method according to claim 3 or 4 in which the masking is achieved by passing the face of the forming wire remote from the slurry across a blinding plate as it passes the slurry.

6. A method according to claim 5 in which the effective width of the blinding plate decreases in the direction in which the forming wire passes the slurry.

7. A method according to any of claims 3 to 6 in which the masking is of the portion of the forming wire corresponding to an edge margin of the formed mat.

8. Apparatus for forming a non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction comprising:

a source of a slurry of inorganic fibre in a liquid;

a forming wire disposed to move past the said source, through which, in use, the said liquid passes to deposit the said inorganic fibre on the forming wire;

a mask across a part of the width of the forming wire to hinder passage of the said liquid through the forming wire over the said part, the effectiveness of the mask varying in the direction of movement of the forming wire past the said source.

9. Apparatus according to claim 8 in which the mask is disposed across portion of the forming wire corresponding to the edge margins of the formed mat.

10. Apparatus according to claim 8 or 9 in which the effectiveness of the mask decreases in the direction in which the forming wire is disposed to move.

11. Apparatus according to claim 8, 9 or 10 in which the mask is a blinding plate impinging the face of the forming wire remote from the source of slurry.

12. Apparatus according to any of claims 8 to 11 in which the effective width of the blinding plate decreases in the direction in which the forming wire passes the slurry.

13. A cementitious board having a sheet of a non-woven mat of inorganic fibre according to claim 1 or 2 embedded immediately below at least one surface.

14. A cementitious board having a sheet of a non-woven mat of inorganic fibre embedded immediately below at least one surface wherein the permeability of the mat to cementitious slurry varies across the mat.

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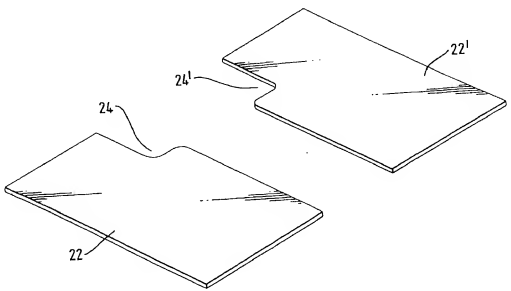
(54) Title: NON–WOVEN INORGANIC FIBRE MAT



(57) Abstract

A non–woven mat (18) of inorganic fibre is disclosed having a substance which is lower at the edges (26') of the mat than in the remainder (28) of the mat. Apparatus for making such a mat comprises: a source of a slurry of inorganic fibre in a liquid; a forming wire disposed to move past the source, through which the liquid passes to deposit the inorganic fibre on the forming wire; a mask across a part of the width of the forming wire to hinder passage of the liquid through the forming wire over the said part, the effectiveness of the mask varying in the direction of movement of the forming wire past the slurry source. A method of making the mat comprises passing a forming wire past a slurry of inorganic fibres in a liquid while masking a part of the width of the forming wire as it passes through the slurry, the masking varying along the length of the forming wire as it passes through the slurry; and urging the slurry against the forming wire and causing the liquid to pass through the forming wire, whereby a non–woven mat of inorganic fibre is formed having an uneven substance (weight/unit area) in the cross direction.

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CLAIMS

1. A non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction.

2. A mat according to claim 1 in which the edge margins are of lower substance than the remainder of the mat.

3. A method of making a non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction comprising:

passing a forming wire past a slurry of inorganic fibres in a liquid while masking a part of the width of the forming wire as it passes through the slurry, the masking varying along the length of the forming wire as it passes through the slurry; and

urging the slurry against the forming wire and causing the said liquid to pass through the forming wire, whereby a non-woven mat of inorganic fibre is formed having an uneven substance (weight/unit area) in the cross direction.

4. A method according to claim 3 in which the masking decreases in the direction in which the forming wire passes the slurry.

5. A method according to claim 3 or 4 in which the masking is achieved by passing the face of the forming wire remote from the slurry across a blinding plate as it passes the slurry.

6. A method according to claim 5 in which the effective width of the blinding plate decreases in the direction in which the forming wire passes the slurry.

7. A method according to any of claims 3 to 6 in which the masking is of the portion of the forming wire corresponding to an edge margin of the formed mat.

8. Apparatus for forming a non-woven mat of inorganic fibre having a substance (weight/unit area) which varies in the cross direction comprising:

a source of a slurry of inorganic fibre in a liquid;

a forming wire disposed to move past the said source, through which, in use, the said liquid passes to deposit the said inorganic fibre on the forming wire;

a mask across a part of the width of the forming wire to hinder passage of the said liquid through the forming wire over the said part, the effectiveness of the mask varying in the direction of movement of the forming wire past the said source.

9. Apparatus according to claim 8 in which the mask is disposed across portion of the forming wire corresponding to the edge margins of the formed mat.

10. Apparatus according to claim 8 or 9 in which the effectiveness of the mask decreases in the direction in which the forming wire is disposed to move.

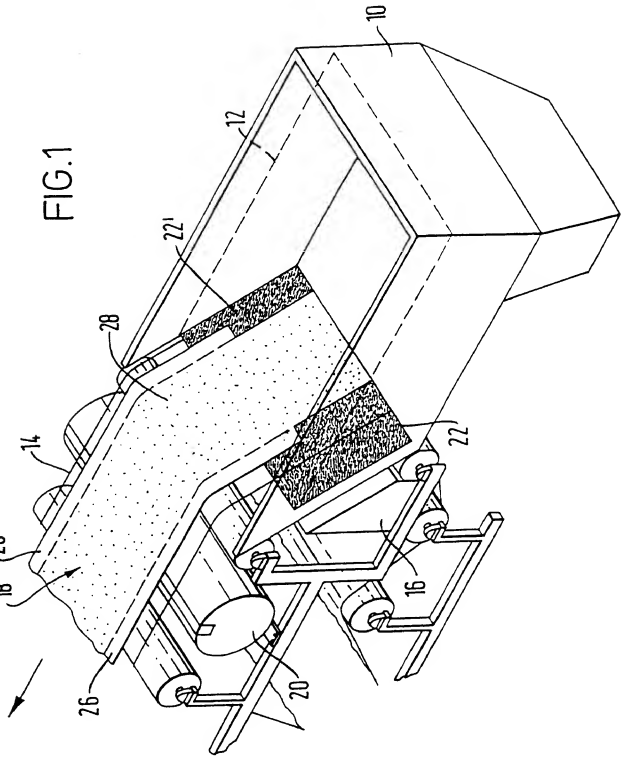
11. Apparatus according to claim 8, 9 or 10 in which the mask is a blinding plate impinging the face of the forming wire remote from the source of slurry.

12. Apparatus according to any of claims 8 to 11 in which the effective width of the blinding plate decreases in the direction in which the forming wire passes the slurry.

13. A cementitious board having a sheet of a non-woven mat of inorganic fibre according to claim 1 or 2 embedded immediately below at least one surface.

14. A cementitious board having a sheet of a non-woven mat of inorganic fibre embedded immediately below at least one surface wherein the permeability of the mat to cementitious slurry varies across the mat.

FIG.1



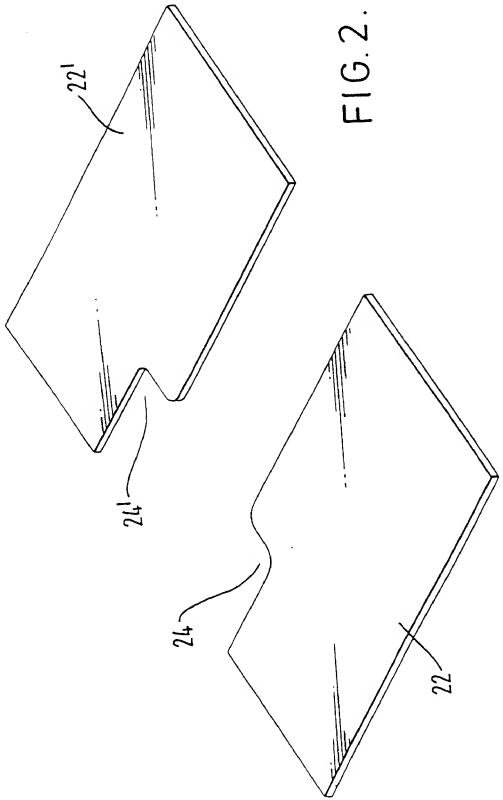
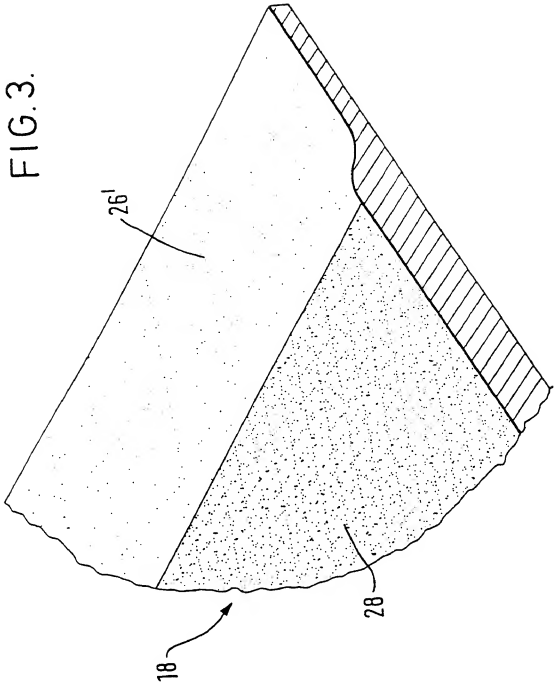


FIG. 2.

FIG. 3.



INTERNATIONAL SEARCH REPORT

Inte. ional Application No
PCT/GB 98/00203

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29B11/16 B29B11/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C D04H B29D E04C B32B B28B B29B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
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[X] Further documents are listed in the continuation of box C

[X] Patent family members are listed in annex

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Date of the actual completion of the international search	Date of mailing of the international search report
1 April 1998	07/04/1998

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No
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ERNATIONAL SEARCH REPO

information on patent family members

Inter .nal Application No
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		ZA 8003205 A	27-05-81

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 37977

Box No. I TITLE OF INVENTION

NON-WOVEN INORGANIC FIBRE MAT

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

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☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

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State *(i.e. country)* of residence: United Kingdom

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

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This person is:

☐ applicant only

☐ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: Republic of Ireland

State *(i.e. country)* of residence: Republic of Ireland

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

MARLOW, Nicholas Simon
Reddie & Grose
16 Theobalds Road
London WC1X 8PL
United Kingdom

Telephone No. 0171 242 0901

Facsimile No. 0171 242 3290

Teleprinter No. 25445

☐ Mark this check-box where no agent or common representative is has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III **FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS**

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

WALTERS, John
29 Roundhill Road
Castleford
West Yorkshire WF10 5AG
United Kingdom

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: United Kingdom

State *(i.e. country)* of residence: United Kingdom

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

FITZSIMONS, Jocelyn
24 Margret Street
Georges Quay
Cork
Ireland

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: Republic of Ireland

State *(i.e. country)* of residence: Republic of Ireland

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

See Notes to the request form

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes, at least one must be marked)*:

Regional Patent

- [X] **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SZ** Swaziland, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- [X] **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- [X] **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- [X] **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- [X] **AL** Albania
- [X] **AM** Armenia
- [X] **AT** Austria
- [X] **AU** Australia
- [X] **AZ** Azerbaijan
- [X] **BA** Bosnia and Herzegovina
- [X] **BB** Barbados
- [X] **BG** Bulgaria
- [X] **BR** Brazil
- [X] **BY** Belarus
- [X] **CA** Canada
- [X] **CH and LI** Switzerland and Liechtenstein
- [X] **CN** China
- [X] **CU** Cuba
- [X] **CZ** Czech Republic
- [X] **DE** Germany
- [X] **DK** Denmark
- [X] **EE** Estonia
- [X] **ES** Spain
- [X] **FI** Finland
- [X] **GB** United Kingdom
- [X] **GE** Georgia
- [X] **GH** Ghana
- [X] **GM** Gambia
- [X] **GW** Guinea-Bissau
- [X] **HU** Hungary
- [X] **ID** Indonesia
- [X] **IL** Israel
- [X] **IS** Iceland
- [X] **JP** Japan
- [X] **KE** Kenya
- [X] **KG** Kyrgyzstan
- [X] **KP** Democratic People's Republic of Korea
- [X] **KR** Republic of Korea
- [X] **KZ** Kazakhstan
- [X] **LC** Saint Lucia
- [X] **LK** Sri Lanka
- [X] **LR** Liberia
- [X] **LS** Lesotho
- [X] **LT** Lithuania
- [X] **LU** Luxembourg
- [X] **LV** Latvia
- [X] **MD** Republic of Moldova
- [X] **MG** Madagascar
- [X] **MK** The former Yugoslav Republic of Macedonia
- [X] **MN** Mongolia
- [X] **MW** Malawi
- [X] **MX** Mexico
- [X] **NO** Norway
- [X] **NZ** New Zealand
- [X] **PL** Poland
- [X] **PT** Portugal
- [X] **RO** Romania
- [X] **RU** Russian Federation
- [X] **SD** Sudan
- [X] **SE** Sweden
- [X] **SG** Singapore
- [X] **SI** Slovenia
- [X] **SK** Slovakia
- [X] **SL** Sierra Leone
- [X] **TJ** Tajikistan
- [X] **TM** Turkmenistan
- [X] **TR** Turkey
- [X] **TT** Trinidad and Tobago
- [X] **UA** Ukraine
- [X] **UG** Uganda
- [X] **US** United States of America
- [X] **UZ** Uzbekistan
- [X] **VN** Viet Nam
- [X] **YU** Yugoslavia
- [X] **ZW** Zimbabwe

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet.

- [ ]
- [ ]
- [ ]

In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of .....

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

See Notes to the request form

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

	Country *(in which or for which the application was filed)*	Filing Date *(day/month/year)*	Application No.	Office of filing *(only for regional or international application)*
item (1)	United Kingdom	24th January 1997	9701500.2	
item (2)				
item (3)				

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required)

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s) : _____

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / EP

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office): EPO

Date *(day/month/year)*: 6th May 1997

Number: RS 98351

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	: 4	sheets
2. description	: 6	sheets
3. claims	: 3	sheets
4. abstract	: 1	sheets
5. drawings	: 3	sheets
Total	: 17	sheets

This international application is accompanied by the item(s) marked below:

1. ☒ separate signed power of attorney
2. ☒ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☒ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☐ other *(specify)*:

Figure No. 2 of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

MARLOW, Nicholas Simon - Authorised Representative

For receiving Office use only

1. Date of actual receipt of the purported international application:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid

2. Drawings:
☐ received:
☐ not received

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

See Notes to the request form

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
NSM/37977		
International application No	International filing date (day/month/year)	Priority date (day/month/year)
PCT/GB98/00203	23/01/1998	24/01/1997

International Patent Classification (IPC) or national classification and IPC
B29B11/16

Applicant
BPB plc

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
06/08/1998	12.04.99

Name and mailing address of the international preliminary examining authority:
European Patent Office
D-80298 Munich
Tel (+49-89) 2399-0 Tx 523656 epmu d
Fax (+49-89) 2399-4465

Authorized officer
Golombek, G

Telephone No. (+49-89) 2399 2909

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB98/00203

I. **Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-6 as originally filed

Claims, No.:

1-11 as received on 06/08/1998 with letter of 06/08/1998

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☒ the claims, Nos.: 12-14
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-11
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-11
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-11
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

to point V

Claim 1

Document D1 = GB-A-2 053 779 discloses a non-woven mat of inorganic fibre having a substance which does not vary in the cross section.

Neither D1 nor the other documents of the search report disclose the variation of the substance in the cross section. Furthermore, a person skilled in the art gets no hint to do so.

Thus, the subject-matter of claim 1 is new and industrially applicable and it involves an inventive step and the claim itself meets the requirements of Article 33 PCT.

Claim 2

D1 discloses a method of making a non-woven mat of inorganic fibre having an isotropic cross section, said method having the steps:

- passing a forming wire past a slurry of inorganic fibres in a liquid,
- urging the slurry against the forming wire and causing said liquid to pass through the forming wire.

Neither D1 nor the other documents of the search report disclose the variation of the substance in the cross section. Furthermore, a person skilled in the art gets no hint to do so.

Thus, the subject-matter of claim 2 is new and industrially applicable and it involves an inventive step and the claim itself meets the requirements of Article 33 PCT.

Claims 3 - 5

These dependent claims disclose embodiments of the method of the invention.

Claim 6

D1 also discloses an apparatus for forming a non-woven mat of inorganic fibre having a cross section which does not vary in the content of fibres, said apparatus comprises:

- a source of a slurry of inorganic fibre in liquid form;
- a forming wire disposed to move past the source;
- a mark across the part of the width of the forming wire.

Neither D1 nor the other documents of the search report disclose the variation of the substance in the cross section using the mask. Furthermore, a person skilled in the art gets no hint for the design of the mask.

Thus, the subject-matter of claim 6 is new and industrially applicable and it involves an inventive step and the claim itself meets the requirements of Article 33 PCT.

Claims 7 - 9

These dependent claims disclose features of the apparatus according to the invention claimed.

Claims 10 and 11

These independent claims disclose products in which the non-woven mat according to claim 1 is integrated.

Thus, the subject-matter of claims 10 and 11 is new and industrially applicable and it involves an inventive step and the claim itself meets the requirements of Article 33 PCT.

to point VII

1 Independent claims 1, 2, 6, 11 and 11 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1 = GB-A-2 053 779,

compare page 1 of the present description) being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

to point VIII

1 Although claims 1, 2, 6, 11 and 11 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 1, 2, 6, 11 and 11 do not meet the requirements of Article 6 PCT.

2 In order to overcome this objection, it would have been appropriate to file an amended set of claims defining the relevant subject-matter in terms of a single independent claim in each category followed by dependent claims covering features which are merely optional (Rule 6.4 PCT).

3 The expression "substance" is very general and brings obscurity to the claims (Article 6 PCT) in which it is used, since this expression can also be used illustrative.
Thus, this expression should have been replaced by the technical feature "weight/unit area" (a feature being in parenthesis cannot be taken into consideration).

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)
PCT/GB 98/00203	23/01/1998	24/01/1997
Applicant		
BPB plc		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] **Certain claims were found unsearchable** (see Box I).

2. [ ] **Unity of invention is lacking** (see Box II).

3. [ ] The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

   [ ] filed with the international application.

   [ ] furnished by the applicant separately from the international application.

   [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

   [ ] Transcribed by this Authority.

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

   Figure No. 2

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/00203

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29B11/16 B29B11/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C D04H B29D E04C B32B B28B B29B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4 415 517 A (DONNY L. TIMMS) 15 November 1983 see the whole document ---	1,2 3-13
Y	GB 2 225 594 A (BISON-WERKE BÄHRE & GRETEN GMBH & CO. KG) 6 June 1990 see the whole document ---	3-13
X	FR 2 504 957 A (BPB INDUSTRIES PUBLIC LIMITED COMPANY) 5 November 1982 see the whole document ---	1,3,8,11
A	FR 981 384 A (MACHINAGGLO) 25 May 1951 see the whole document --- -/--	1,2

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search
1 April 1998

Date of mailing of the international search report
07/04/1998

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl
Fax (+31-70) 340-3016

Authorized officer
Molto Pinol, F

Form PCT/ISA/210 (second sheet) (July 1992)

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 106 (C-0919), 16 March 1992 & JP 03 279456 A (TOYOTA MOTOR CORP.), 10 December 1991. see abstract & DATABASE WPI Section Ch, Week 9204 Derwent Publications Ltd., London, GB; Class F, AN 92-030709 (04) & JP 03 279 456 A (TOYOTA JIDOSHA K.K.) . 10 December 1991 see abstract	1,3,8
A	EP 0 579 007 A (PAUL MALER) 19 January 1994 see the whole document	1
A	DE 195 07 040 A (GERO STEIGERWALD AND DIPL.-ING. ALEXANDER HUFGARD) 12 September 1996 see the whole document	1
A	GB 2 053 779 A (BPB INDUSTRIES LIMITED) 11 February 1981 cited in the application see the whole document	3,8,14

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 98/00203

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4415517 A	15-11-83	NONE	
GB 2225594 A	06-06-90	DE 3840718 A	07-06-90
		US 5277856 A	11-01-94
FR 2504957 A	05-11-82	AU 547801 B	07-11-85
		AU 8318382 A	04-11-82
		BE 893027 A	29-10-82
		CA 1189719 A	02-07-85
		DE 3216072 A	20-01-83
		JP 1759201 C	20-05-93
		JP 4008579 B	17-02-92
		JP 57187460 A	18-11-82
		NL 8201677 A	01-12-82
		SE 8202698 A	02-11-82
		US 4630419 A	23-12-86
FR 981384 A	25-05-51	NONE	
EP 579007 A	19-01-94	DE 4223508 A	20-01-94
DE 19507040 A	12-09-96	IT RM960138 A	29-08-97
GB 2053779 A	11-02-81	AT 385233 B	10-03-88
		AU 531527 B	25-08-83
		AU 5872880 A	04-12-80
		BE 883527 A	01-12-80
		CA 1148458 A	21-06-83
		CH 637320 A	29-07-83
		DE 3019917 A	11-12-80
		DK 231180 A,B,	01-12-80
		FI 801765 A	01-12-80
		FR 2457754 A	26-12-80
		JP 1026845 B	25-05-89
		JP 1551685 C	23-03-90
		JP 55162487 A	17-12-80
		JP 1520405 C	29-09-89
		JP 63065482 B	15-12-88
		JP 63172607 A	16-07-88
		LU 82494 A	08-10-80

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2053779 A		NL 8003121 A	02-12-80
		SE 441610 B	21-10-85
		SE 8004007 A	01-12-80
		SU 1706381 A	15-01-92
		US 4378405 A	29-03-83
		ZA 8003205 A	27-05-81